

Abstracts of Bell System Technical Papers Not Appearing in the Bell System Technical Journal

*Photomechanical Wave Analyzer Applied to Inharmonic Analysis.*¹
C. F. SACIA. This type of Fourier Analysis deals with wave-forms which are not strictly periodic, since they are of finite duration and of varying cyclic forms. Hence in a finite frequency range they have an infinite number of infinitesimal components (shown by the Fourier Integral) as contrasted with the finite number of finite components at regular intervals (shown by the Fourier Series).

This analyzer utilizes the continual repetition of the aperiodic wave, deriving therefrom a periodic wave, the infinitesimal components neutralizing except for frequencies which are integral multiples of the frequency of repetition; here the components build up to finite magnitudes. The simple relation between these components is seen from the corresponding Fourier Integral and Series identities for the unrepeatd and repeated waves respectively. By increasing the period of repetition a new set of components can be similarly derived.

The wave form is represented as a black profile on a transparent strip whose ends are joined to form an endless belt. Driven at constant speed past a transverse illuminated slit, it generates light fluctuations which are converted into electrical fluctuations by means of a selenium cell. A tuned circuit, amplifier, rectifier and microammeter are used to select and measure the components, while the frequencies are determined by the speed of the strip, the frequency of tuning, and the time scale of the original wave form.

*"Demagnetization and Hysteresis Loops."*² L. W. MCKEEHAN and P. P. CIOFFI. The fact that permalloy shows its maximum initial permeability in the absence of external magnetic fields is used to check the exact compensation of the earth's magnetic field or other stray fields by measurement of the initial permeability of a strip or wire of permalloy placed parallel to the field component to be compensated. Increased accuracy is obtained by the use of somewhat greater fields than those which approximately give the initial permeability. The effect of demagnetization by an alternating current field is studied with samples of the same sort, the apparent permeability varying as the external field at the time of magnetization is varied. The dissymmetry in hysteresis loops where the upper and lower limits

¹ J. O. S., R. S. I., Vol. 9, pp. 487-494, 1924.

² J. O. S., R. S. I., Vol. 9, pp. 479-485, 1924.

are unsymmetrical with respect to the zero of magnetic field is illustrated and the detection of such dissymmetry is discussed.

*A Classified List of Published Bibliographies in Physics, 1910-1922.*³
KARL K. DARROW. This work, undertaken at the request of the National Research Council, represents an attempt to cope with the problem of providing a convenient and adequate bibliography of physics, not by actually writing a complete classified bibliography (which would fill a huge volume and require the prolonged labor of several men), but by listing the very numerous partial bibliographies under a detailed subject-classification. Many of the accounts of research published in scientific journals contain short histories of the previous work in the subjects which they treat, many others contain lists of references, and there are also a number of critical or uncritical reviews of particular fields with thorough documentations. The *Classified List of Published Bibliographies* refers to all of these which appeared in any of the familiar physical journals between 1910 and 1922 inclusively, and a number of books as well; it is believed that almost every article upon a physical subject, which has ever been cited or reviewed in another article, can be traced through the *List*. The system of classification, in which the field of physics is divided into seventy-five classes with numerous subdivisions, is much the most detailed and elaborate which has been made out for the science of physics in a score of years. An adequate system of classification is of great value in any science, for researches which are clasified under it are not only made easy to trace, but their various aspects and their mutual relations can be emphasized. Because of the rapid growth and evolution of physics, the earlier systems have mostly become inadequate; but it is hoped to make and keep this system effective by constant attention and revision, and to extend the use of it.

*Transmitting Equipment for Radio Telephone Broadcasting.*⁴
EDWARD L. NELSON. The general transmission considerations applying to any system for the high quality transmission of speech or music are outlined briefly, and the specific requirements to be met by the various apparatus units in a radio broadcasting equipment are discussed in some detail. The standard Western Electric 500-watt broadcasting equipment, which has found application in some fifty of the larger stations in this country and abroad, is described. Its performance capabilities are illustrated and it is indicated that a standard of performance has been attained which renders possible reproductions not substantially different from the original.

³ Bulletin of the National Research Council, No. 47.

⁴ Proc. of The Inst. of Radio Engineers, Vol. XII, page 553, 1924.

*"The Vapor Pressures of Rochelle Salt, the Hydrates of Sodium and Potassium Tartrates and Their Saturated Solutions."*⁵ H. H. LOWRY and S. O. MORGAN. The vapor pressures were determined by a static method at several temperatures between 15° and 40°. Temperatures were controlled to $\pm 0.1^\circ$ and the pressures read to ± 0.1 mm. The measurements on the saturated solution of Rochelle salt show that the solid phase in such a solution is unstable above 40°, in agreement with other investigators.

*Minimal Length Arc Characteristics.*⁶ H. E. IVES. This paper is a study of the electrical discharges which occur between opening contacts. It is found that the discharge occurring when currents below a certain value are broken are atmospheric sparks corresponding to a definite breakdown voltage, which in the case of air is about 300 volts. Above a critical value of current, which is different for every material, the discharge is an arc, in which the voltage corresponding to the discharge varies with current. Spectograms taken in the two regions show only the air spark spectrum for all materials below the critical current and the arc spectra of the materials above the critical current. The characteristic equations of the arcs caused by the opening contacts are derived and are used to obtain expressions for the current vs. time relations at the opening contact.

*The Dependence of the Loudness of a Complex Sound Upon the Energy in the Various Frequency Regions of the Sound.*⁷ H. FLETCHER and J. C. STEINBERG. Two complex sounds were studied, one with a continuous energy frequency spectrum corresponding to connected speech, the other a test tone having discrete frequency components. By means of filters the energy was removed from all frequencies either above or below a certain frequency, and the resulting decrease in loudness was measured by attenuating the original sound without distortion until equal in loudness to the filtered sound. Taking the average results for six observers, this decrease was found to depend on the absolute values of the loudness. For a loudness of 22 units above threshold, each frequency region contributes to loudness in proportion to the energy in that region weighted according to the threshold energy for that frequency. For a loudness above 30 units, however, this is no longer true, because of the non-linear character of the response of the ear. By assuming each frequency region contributes in proportion to a fractional power of the weighted energy of that region, values of the total loudness in agreement with ob-

⁵ Jour. Am. Chem. Soc., Vol. 45, pp. 2192-2196, 1924.

⁶ Journal of the Franklin Institute, Vol. 198, pp. 437-474, 1924.

⁷ Physical Review, Vol. 24, page 306, 1924.

served values are obtained if proper values are taken for the fractional power, decreasing to one third as the loudness increases to 100 units.

*Correlation Between Crack Development in Glass While Conducting Electricity and the Chemical Composition of the Glass.*⁸ EARLE E. SCHUMACHER. A study was made of the susceptibility to crack development shown by five different kinds of glass when they were subjected to the action of an electric current. The results indicated that the tendency to crack increased with increasing alkali content of the glass and with increasing electrical conductivity.

*Report of the Chairman of the Telegraphy and Telephony Committee of the American Institute of Electrical Engineers.*⁹ O. B. BLACKWELL. This report gives a brief summary of the advances which have been made or which have come into prominence in the communication art during the year. Papers which have been presented before the Institute and which, in general, have recorded such advances are reviewed.

*Selective Circuits and Static Interference.*¹⁰ J. R. CARSON. This paper is an application of a general mathematical theory to the question as to the possibilities and limitations of selective circuits when employed to reduce "Static" interference. In the case of static interference and random disturbances in general the random and unpredictable character of the disturbances makes it necessary to treat the problem statistically and express the results in mean values. In spite of the meagre information available regarding the character and frequency distribution of static, this treatment of the problem yields general deductions of practical significance. The conclusion is reached that for given signal requirements there is an irreducible residue of static interference which cannot be eliminated. This limit is closely approached when a filter of only two or three sections is employed as the selective circuit, and only a negligible further gain is made possible by the most elaborate circuit arrangements. A formula is also given for calculating the relative figures of merit of selective circuits with respect to random interference.

*The Guided and Radiated Energy in Wire Transmission.*¹¹ J. R. CARSON. This is a mathematical analysis of wave propagation along guiding wires from the fundamental equations of electromagnetic theory. It is shown that the engineering theory of wire transmission is incomplete, and that, in addition to the transmitted wave of en-

⁸ Jour. Am. Chem. Soc., Vol. XLVI, No. 8, August, 1924.

⁹ Journal of the American Inst. of Elec. Engineers, Vol. 43, page 1083, 1924.

¹⁰ Trans. A. I. E. E., 1924.

¹¹ Jour. A. I. E. E., Oct., 1924.

gineering theory, an infinite series of complementary waves exist. It is through these waves that the phenomena of radiation are directly accounted for. Except for the phenomena of radiation, however, the complementary waves are of theoretical rather than practical interest in present-day transmission practice, and except in extreme cases they may be ignored in practice without appreciable error.

*Sound Magnification and Its Application to the Requirements of the Deafened.*¹² HARVEY FLETCHER. A general description of the generation and propagation of sound waves was given and experiments performed to illustrate the principles involved. The general requirements for aiding persons having various amounts of deafness were outlined. The relation between the loudness of speech received by the ear in a room of average acoustic characteristics and the distance the speaker is away from the ear was illustrated by a chart. Also, a chart showing the characteristic frequency regions and loudness levels of the fundamental speech sounds, and one showing the interpretation of speech at various loudness levels by persons having various degrees of hearing, were exhibited. By means of these three charts it was shown how one could predict the amount of intelligibility which would be obtained by a person having a definitely measured amount of hearing. In particular it was pointed out that such sounds as *th*, *f*, and *v* will be the first sounds to be lost as the hearing decreases. These sounds are the easiest ones to detect by lip reading so that hearing aids and lip reading go hand in hand in aiding one who is hard of hearing to obtain the proper interpretation.

*Abstract of a Telephone Transmission Reference System.*¹³ L. J. SIVIAN. The subject is dealt with in four parts: A—The function of a transmission reference system; B—Requirements to be met by the reference system; C—Work done on the construction and calibration of a preliminary model of the new reference system; D—Proposed future development of the new reference system in its final form to be adopted as the standard for the Bell System.

A brief discussion of the methods and apparatus entering into the general problem of rating telephone transmission is given. It is

¹² Lecture given before the Annual Conference of the American Federation of Organizations for the Hard of Hearing, Washington, D. C., Thursday, June 5, and published in *Volta Review*, September, 1924.

A large number of the audience who listened to this lecture were hard of hearing. A rough measurement of the amount of hearing of each of those present was made and groups arranged according to the degree of hearing. The amplification was then adjusted to each group to suit their particular needs. The results seemed to be most gratifying, as nearly everybody said that it was the first time they ever heard a public lecture of this sort without difficulty since they had become hard of hearing.

¹³ *Electrical Communications*, Vol. III, pp. 114-126, 1924.

concluded that a physical reference system is essential, and that a mere specification of its physical operating characteristics is insufficient. The inadequacy of the reference systems now in use is pointed out.

The conditions to be aimed at in the new reference system are: I—The performance of the system and of its component parts must be specifiable in terms of quantities admitting of definite physical measurement; II—The performance of the reference system, under specified operating and atmospheric conditions, must remain constant with time; III—The reference system must be free from non-linear distortion over the range of acoustic and electric amplitudes which it must handle; IV—The frequency response over the range of speech frequencies must be as nearly uniform as possible.

Of the above, conditions I and II are regarded as the most important. It is also proposed to build auxiliary reference systems which will meet conditions I and II while falling short of III and IV. These are needed for purposes of ready comparisons with the commercial circuits commonly in use.